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The Diet, Physical Activity and Accommodation of Patients with Quiescent Pulmonary Tuberculosis in a Poor South Indian Community *

A Four-Year Follow-up Study

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A previous report from the Tuberculosis Chemotherapy Centre, Madras, has shown that, if standard chemotherapy is given for one year, the response of patients treated at home in very poor environmental circumstances is nearly as good as that of those treated in sanatorium under much more favourable conditions. This paper reports on a four-year follow-up of all the patients whose disease was bacteriologically quiescent at the end of the year's treatment. During this period, all the patients were managed on a domiciliary basis : about a quarter of them received chemotherapy with isoniazid alone for two years, another quarter received the drug for one year and the rest received no specific chemotherapy. Despite adverse environmental factors (poor diet ; long hours of work often involving strenuous physical activity ; overcrowded living conditions ; and, for the sanatorium patients, the stresses of returning suddenly to the unfavourable home environment), the great majority of patients in both series maintained quiescent disease throughout the follow-up period. Furthermore, the few patients whose disease relapsed bacteriologically were at no special dietary disadvantage in comparison with those who maintained quiescent disease throughout, nor did they show any appreciable differences in occupation, physical activity or living accommodation. These findings, together with the earlier ones, indicate that, despite adverse environmental circumstances, standard chemotherapy for an adequate period of time is sufficient in the great majority of patients for the attainment of bacteriological quiescence and its maintenance thereafter.

A previous communication from the Tuberculosis Chemotherapy Centre, Madras, presented the results of a study of the influence of diet on the response to treatment of patients with pulmonary tuberculosis receiving a standard combination of antituberculosis drugs for one year (Ramakrishnan et al., 1961). The dietary study was undertaken in the course of a controlled comparison of treatment at home with treatment in sanatorium for a year with isoniazid plus PAS in patients who were drawn from a malnourished poverty-stricken section of the community in Madras City (Tuberculosis Chemotherapy Centre, 1959). It was found that the response to treatment was not influenced by the diet during the year; thus, the difference between the home and the sanatorium series in the proportion of patients whose disease attained bacteriological quiescence at one year was small even though the diet of the patients treated at home was clearly inferior in terms of total calories, total and animal proteins, fats, several of the vitamins and phosphorus, an inferiority which was further accentuated by the much greater physical activity of the patients in the home series.

All the patients in the home series and in the sanatorium series who had bacteriologically quies-

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cent disease at one year have subsequently been followed up for four years. Their diet was assessed on two occasions in the second year and two in the third year, in order to study the relationship between diet and the occurrence of bacteriological relapse. However, because there were few bacteriological relapses, the present report is principally concerned with the diet, physical activity and accommodation of patients in whom bacteriological quiescence was maintained throughout the four years of follow-up.

I. GENERAL PLAN AND CONDUCT OF THE STUDY

THE PATIENTS IN THE PRESENT ANALYSIS

An earlier report (Tuberculosis Chemotherapy Centre, 1959) has described the progress during a year of chemotherapy with isoniazid plus PAS of 163 patients with extensive pulmonary tuberculosis. These patients had presented themselves at local chest clinics because of symptoms and, in most cases, had received no antituberculosis chemotherapy (two patients had received up to two weeks of chemotherapy). They were allocated at random to treatment for one year at home or in sanatorium and, at the end of the year, 130 patients had attained bacteriologically quiescent disease. Of these, three (all home patients) have been excluded from the present study; one died of carcinoma of the oesophagus in the 15th month, another died suddenly in the 17th month of a non-tuberculous condition and the third refused to co-operate in the dietary assessments. There remain 127 patients in the present study of whom 57 had been treated at home and 70 in sanatorium in the first year. Of these patients, 63 (30 home, 33 sanatorium) received a placebo, calcium gluconate (500 mg a day in one tablet), in the second year; 63 (26 home, 37 sanatorium) received isoniazid (150,175 or 200 mg a day, depending on the body-weight); and one received isoniazid plus PAS. In all except three patients the allocation was made at random. Of the 63 patients who received the placebo in the second year, 58 had quiescent disease at two years and therefore received the placebo in the third year also. Of the 63 patients who received isoniazid in the second year, 61 still had quiescent disease at two years, and, of these, 31 received the placebo in the third year and 30 isoniazid, the treatment being allocated at random for all except one patient. All patients with quiescent disease at three years received the placebo in the fourth year and all with quiescent disease at four years received no medicament in the fifth year.

GENERAL MANAGEMENT AND ROUTINE INVESTIGATIONS

The management of patients in both series has already been reported in detail in earlier reports (Tuberculosis Chemotherapy Centre, 1959; Velu et al., 1960; Devadatta et al., 1961). Briefly, the patients in the home series were treated in their own homes from the beginning, with clinic supervision. The patients in the sanatorium series were treated in sanatorium for one year, after which they continued their treatment in their own homes, with clinic supervision. All the patients in both series attended the clinic monthly in the second year and once in every three months in the third, fourth and fifth years. Their examinations at each attendance included a chest radiograph and weight measurement, and a record was kept of the patient's physical activity and occupation. In the second year, an overnight specimen of sputum or a pair of laryngeal swabs was examined by culture for tubercle bacilli and, thereafter, a minimum of two cultures was examined every three months.

DIETARY ASSESSMENTS

Dietary assessments were performed on admission to treatment, at some time between 6 and 12 months, and at 18, 24, 30 and 36 months. All the assessments were made by one of us (K.R.). The method of conducting the dietary assessments, reported in detail earlier (Ramakrishnan et al., 1961). was as follows :

All the patients were carefully interrogated and, sometimes, other members of the family were also questioned to elicit precise information on the amounts of different articles of food consumed by the patient and the various members of the family in the course of the day. It is usually possible to make a fairly accurate assessment of an individual's dietary intake by assessing the total quantity of food

consumed by the whole family and, on the basis of adult equivalents (Aykroyd, Patwardhan & Ranganathan, 1951), calculating the proportion of food consumed by the individual. This method has been used by the Nutrition Research Laboratories of the Indian Council of Medical Research (Pasricha, 1958, 1959). However, most of the patients in the present study were seriously ill when treatment was originally started (Tuberculosis Chemotherapy Centre, 1959) and had little or no appetite so that they were consuming very much less than their normal intake of food (Ramakrishnan et al., 1961). In such circumstances, the adult equivalent method would give misleadingly high values; therefore, the patients were asked to express, with the aid of standard vessels, the actual quantities of food they ate. The adult equivalent was applied only for items like oil, dhal (pulses) and sugar, where it is difficult to express the actual quantity consumed. Special articles of diet consumed by the patient alone–for example, eggs or fruit–were also taken into consideration in calculating the dietary intake of the patient. Since the above procedure was used for the pretreatment assessment, it was used for all the subsequent dietary assessments also, so as to maintain comparability. The reliability of this oral questionnaire technique was confirmed in a comparison with the weighment method, both in the home patients and in the sanatorium patients (Ramakrishnan et al., 1961).

DEFINITIONS OF BACTERIOLOGICALLY QUIESCENT AND BACTERIOLOGICALLY RELAPSED DISEASE

Bacteriologically quiescent disease

(a) At one year. A patient's disease was classified as bacteriologically quiescent if all the cultures for at least the last three monthly examinations (that is, those at 10, 11 and 12 months) were negative.

(b) During the four-year period of follow-up. Patients who yielded only negative cultures, or an isolated positive culture among a series of negative ones, were considered to have bacteriologically quiescent disease throughout the four-year period of follow-up.

Bacteriologically relapsed disease

If a patient yielded two or more positive cultures in a period of six months, the disease was considered to have relapsed bacteriologically. In the second year this meant two or more positive cultures in seven consecutive monthly examinations. In the subsequent years, when two cultures were examined every three months, this meant two or more positive cultures in three consecutive examinations–for example, at 27, 30 and 33 months.

PLAN OF THE REPORT

Section II gives the relapse rates in the four-year period of follow-up, separately for the home and the sanatorium series. Section III considers in detail the diet, weight changes, physical activity, occupation and accommodation of the patients whose disease remained bacteriologically quiescent throughout the four-year period of follow-up. The findings for the home and the sanatorium series are presented separately, because there were large dietary differences between the two series in the first year. The corresponding details for the small numbers of patients whose disease relapsed bacteriologically are presented in section IV. Section V considers the role of chemotherapy in the prevention of relapse, section VI is the discussion and section VII the summary.

II. RELAPSE RATES IN THE FOUR-YEAR PERIOD OF FOLLOW-UP

HOME SERIES

Of the 57 patients in the home series, 5 (9%) had a bacteriological relapse in the 15th, 16th, 22nd, 27th and 57th months, respectively. Thus the great majority of patients had quiescent disease throughout the four-year period of follow-up.

SANATORIUM SERIES

Of the 70 patients in the sanatorium series, 7 (10 %) had a bacteriological relapse in the 13th, 14th, 14th, 15th, 17th, 18th and 54th months, respectively. As in the home series, the great majority of patients maintained quiescent disease throughout the four-year period of follow-up.

III. PATIENTS WITH BACTERIOLOGICALLY QUIESCENT DISEASE THROUGHOUT THE FOUR-YEAR PERIOD OF FOLLOW-UP

HOME SERIES

Dietary intake [1]

The intake of the main dietary factors at the five assessments in the first three years after admission to the study is set out in Table 1 for the 52 patients in the home series who had quiescent disease throughout the follow-up period.

Calories. The total daily intake was less than 1800 calories in 37% of the patients at the assessment in the first year, in 38 % at 18 months, and in 54%, 36% and 39 % at 24, 30 and 36 months, respectively. At each of the five assessments, about one-fifth of the patients had a daily intake of 2600 calories or more.

Proteins. The total daily protein intake was less than 50 g in 50% of patients at the assessment in the first year, in 58 % at 18 months, and in 62%, 54% and 65 % at 24, 30 and 36 months, respectively. The data for animal protein intake have not been tabulated here, but a large majority of the patients had a daily intake of less than 20 g–namely, 77% at the assessment in the first year, 92 % at 18 months, 90% at 24, 94% at 30 and 92% at 36 months. The proportions with a daily intake of less than 10 g of animal protein were 42 %, 37 %, 46 %, 58 % and 65 %, respectively.

Fats. Only a small proportion of patients had a daily intake of fats of 40 g or more at any of the five assessments and the intake was less than 20 g in 63% of the patients during the first year, in 56% at 18 months, and in 65 %, 66% and 65 % at 24, 30 and 36 months, respectively.

Carbohydrates. A considerable majority of the patients at each of the five assessments had a daily intake of 300 g or more of carbohydrates; the proportion who had 400 g or more was 50% during the first year, 48 % at 18 months, 42% at 24, 50% at 30 and 51% at 36 months.

In summary, the intake of the proximate principles (proteins, fats and carbohydrates) and calories was similar at the five assessments in the first three years.

Minerals and vitamins. The intake of certain minerals-namely, calcium, phosphorus and iron–and of vitamin A, carotene, thiamine, riboflavine, nicotinic acid and ascorbic acid was calculated from the assessments of the diet during the first year only. In view of the fact that the intake of minerals and vitamins is generally associated with that of proteins and fats in the poorer segments of the population (C. Gopalan, personal communication), and because the intake of proximate principles by the patients at each of the various assessments was similar, the intake of minerals and vitamins was not calculated for the later periods, but was presumed to be of the same order as in the assessment undertaken during the first year. The calculations here are based on the mineral and vitamin contents of uncooked foodstuffs and, as such, the results do not take into account loss in cooking. The findings are described below, but have not been tabulated in this report.

Calcium : The daily intake of calcium was less than 1 g in 41 (79%) of the patients, 15 (29%) receiving less than 0.5 g a day. However, 79% of the patients chewed betel leaves to which slaked lime had been added; this additional source of calcium has not been taken into account in the calculations.

Phosphorus : The daily intake of phosphorus was less than 1 g in 21 (40%) of the patients and between 1 g and 1.5 g in 23 (44 %).

Iron : The daily intake of iron was less than 20 mg in 25 (48%) of the patients, between 20 and 30 mg in 17 (33 %) and 30 mg or more in 10 (19 %).

Vitamin A : The intake of vitamin A was less than 1000 IU daily in 50 (96%) of the patients and less than 500 IU in 46 (88 %).

Carotene : The daily intake of carotene was less than 1000 IU in 35 (67%) of the patients. Only 6 (12%) had a daily intake of 1600 TU or more.

[1] 'The daily allowances recommended by the Nutrition Advisory Committee of the Indian Council of Medical Research for adults in all types of work are 45-55 g of protein, 1 g of calcium, 20-30 mg of iron, 3000-4000 IU of vitamin A, 1-2 mg of thiamine and 50 mg of ascorbic acid. The amount of fats recommended as " probably desirable " is 45-60 g, of riboflavine is 1500 µg and of nicotinic acid is 4-19 mg. The rest of the diet is to be composed of carbohydrates, the calorific value of which, together with that of proteins and fats, should amount to 2000-2400 for sedentary workers, 2300-2800 for those engaged in moderately strenuous work and 3000-3900 for those doing heavy work (Aykroyd, Gopalan & Balasubramanian, 1963).

TABLE 1. DIETARY INTAKE OF PATIENTS IN THE HOME SERIES WHO HAD BACTERIOLOGICALLY QUIESCENT DISEASE THROUGHOUT THE FOUR-YEAR PERIOD OF FOLLOW-UP

Dietary intake	Time of assessment									
	During the first year		18 months		24 months		30 months		36 months	
	No.	%	No.	%	No.	%	No.	%	No.	%
Calories:										
Less than 1 400	5	10	9	17	9	17	9	18	10	20
1 400 - 1 799	14	27	11	21	19	37	9	18	10	20
1 800 - 2 199	12	23	14	27	6	15	15	30	11	22
2 200 - 2 599	10	19	6	12	5	10	9	18	10	20
2 600 or more	11	21	12	23	11	21	8	16	10	20
Total proteins (g):										
Less than 30	3	6	5	10	5	10	8	16	7	14
30-39	10	19	13	25	11	21	6	72	11	22
40-49	13	25	12	23	16	31	13	26	15	29
50-59	13	25	9	17	10	19	15	30	7	14
60-69	6	12	7	13	7	13	3	6	7	14
70 or more	7	13	6	12	3	6	5	10	4	8
Fats (g):										
O-9	13	25	14	27	12	23	16	32	13	25
10-19	20	38	15	29	22	42	17	34	20	39
20-29	7	13	14	27	11	21	11	22	10	20
30-39	7	13	6	12	7	13	6	12	4	8
40-49	2	4	1	2	0	0	0	0	2	4
50 or more	3	6	2	4	0	0	0	0	2	4
Carbohydrates (g):										
Less than 200	3	6	2	4	1	2	3	6	3	6
200-299	5	10	9	17	11	21	7	14	7	14
300-399	18	35	16	31	18	35	15	30	15	29
400-499	11	21	14	27	10	19	13	26	14	27
500 or more	15	29	11	21	12	23	12	24	12	24
Total patients	52	100	52	100	52	100	50[a]	100	51[b]	100

[a] Excluding two patients who were not assessed. [b] Excluding one patient who was not assessed.

Thiamine : The intake of thiamine was less than 400 IU[1] in 25 (48 %) of the patients and more than 600 IU in 10 (19 %).

Riboflavine : Less than 500 µg of riboflavine daily was received by 48 (92 %) of the patients.

Nicotinic acid: The intake of nicotinic acid was less than 15 mg a day in 14 (27%) of the patients, between 15 and 25 mg in 28 (54 %) and 25 mg or more in 10 (19 %).

Ascorbic acid: The intake of ascorbic acid was less than 25 mg in 14 (27%) of the patients; the

[1] 333 IU = 1 mg.

TABLE 2. WEIGHT CHANGES IN THE PATIENTS WITH BACTERIOLOGICALLY QUIESCENT DISEASE THROUGHOUT THE FOUR-YEAR PERIOD OF FOLLOW-UP

Period (months)	Home series				Sanatorium series			
	Males		Females		Males		Females	
	No. of patients weighed [a]	Average weight change (lb) [b]	No. of patients weighed [c]	Average weight change (lb) [b]	No. of patients weighed [a]	Average weight change (lb) [b]	No. of patients weighed [c]	Average weight change (lb) [b]
0-6	34	+ 9.5	15	+ 11.7	36	+ 15.3	26	+ 16.5
6-12	34	+ 1.3	15	+ 1.3	36	+ 2.2	26	+ 7.2
12-18	32	- 0.5	16	- 0.7	37	- 2.4	23	- 4.1
18-24	32	+ 0.2	15	- 1.6	37	- 1.6	22	- 2.3
24-36	34	+ 0.2	14	0.0	37	+ 0.2	24	- 3.8
36-48	33	+ 1.0	15	+ 1.0	36	+ 0.5	21	- 1.6
48-66	32	+ 0.8	16	+ 1.2	36	+ 0.2	21	+ 1.0
0-60	32	+13.4	18	+12.8	36	+ 13.2	25	+ 14.6

[a] Excluding patients whose weight assessments were not available at the beginning or at the end of the period.
[b] 1 lb. = 0.45 kg. [c] Excluding patients while they were pregnant.

FIG. 1
WEIGHT CHANGES OVER THE 60-MONTH PERIOD, ACCORDING TO SEX OF PATIENTS AND PLACE OF TREATMENT IN THE FIRST YEAR

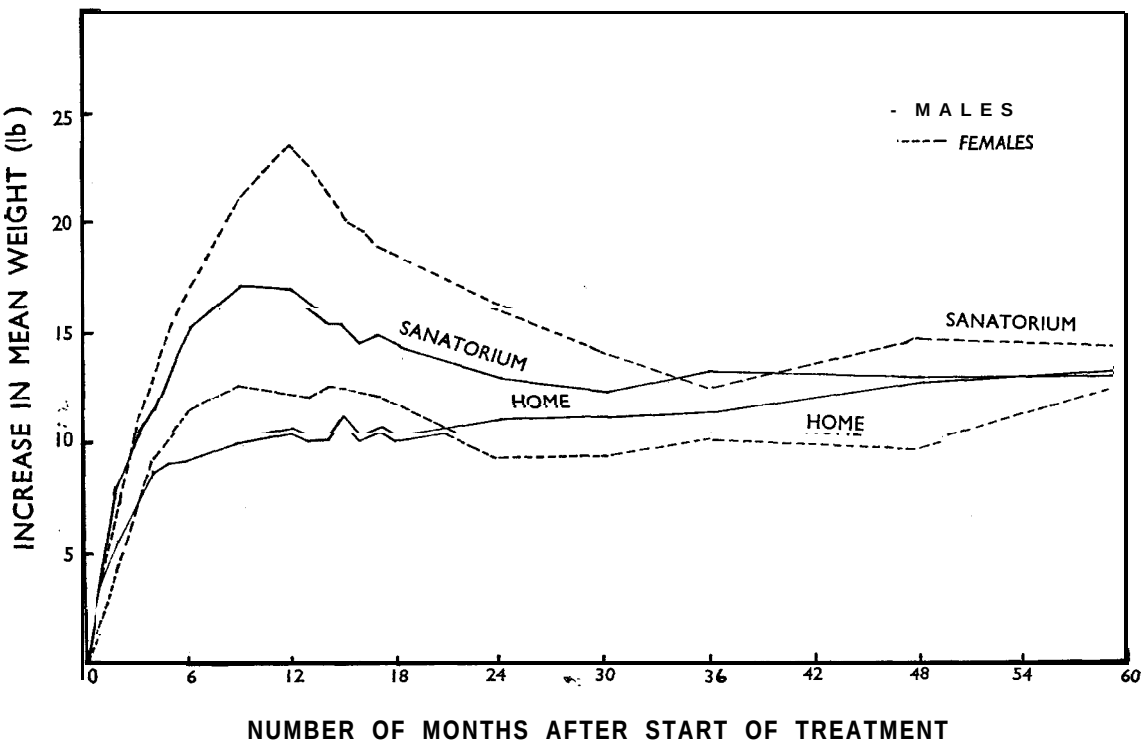

TABLE 3

PHYSICAL ACTIVITY OF PATIENTS WITH BACTERIOLOGICALLY QUIESCENT DISEASE THROUGHOUT THE FOUR-YEAR PERIOD OF FOLLOW-UP

Physical activity	Home series								Sanatorium series							
	At 12 months		At 18 months		At 24 months		At 36, 48 60 months		At 12 months		At 13 months		At 18 months		24 months	At 36, 48 60 months
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No. %	No. %
Resting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 0	0 0
Slight	5	10	0	0	0	0	0	0	63	100	9	14	0	0	0 0	0 0
Part-time	22	42	6	12	2	4	0	0	0	0	24	36	9	14	1 2	1 2
Full-time	25	48	46	88	50	96	52	100	0	0	30	48	54	86	62 98	62 98
All patients	52	100	52	100	52	100	52	100	63	100	63	100	63	100	63 100	63 100

great majority-namely, 45 (87 %)–had an intake of less than 100 mg a day.

In summary, the patients had, on the average, a diet which was low in calories, in both total and animal proteins and in fats; further, a number of patients had a diet deficient in phosphorus, iron and vitamins. The main dietary constituent was carbohydrates for practically all the patients.

Weight changes

The weight changes are set out, separately for the males and females, in the left-hand side of Table 2 and in Fig. 1.

The males gained, on the average, 9.5 lb [1] in the first 6 months and 1.3 lb in the second 6 months. Thereafter there were only minor changes in weight. Over the five-year period, there was an average increase in weight of 13.4 lb. The females gained, on the average, 11.7 lb in the first 6 months and 1.3 lb in the second 6 months. There was, on the average, a small weight loss in the second year, no change in the third year and a small gain in the fourth and fifth years. Over the five-year period there was an average increase in weight of 12.8 lb. Thus, for both sexes, the main change in weight occurred in the first 6 months.

Physical activity and occupation

Many of the patients had already returned to their normal occupations during the first year of treatment (Tuberculosis Chemotherapy Centre, 1959) and at 12 months 90% were on part-time or full-time activity (left-hand side of Table 3). At 18 months 88% were undertaking full-time activity and at 24 months 96%. All the patients with quiescent disease were on full-time activity at the assessments at 36, 48 and 60 months.

The main occupation of the home patients in the second year is shown in Table 4. Of the 52 patients, six were unemployed and nine were housewives. The remaining 37 were engaged in a variety of occupations, many in full-time employment in trades which involved long hours of work and considerable physical activity in a humid tropical climate.

TABLE 4

OCCUPATION OF THE PATIENTS IN THE SECOND YEAR

Occupation	Home series	Sanatorium series
Unemployed	6	2
Housewife	9	18
Craftsman or skilled worker	7	10
Heavy unskilled	5	4
Light unskilled	10	15
Clerical or professional	6	3
Shopkeeper or tradesman	7	9
Other	2	2
Total	62	63

[1] 1 lb = 0.45 kg.

TABLE 5

AREA OF LIVING ACCOMMODATION PER PERSON IN THE FAMILIES AT THE TIME OF ADMISSION OF THE PATIENTS *TO* TREATMENT

Area per person [a] (ft^2) [b]	Home series		Sanatorium series	
	No.	%	No.	%
Homeless	1	2	3	5
5-14	5	10	6	10
15-24	17	33	13	29
25-34	11	21	17	27
35-44	6	12	6	13
45-54	5	10	3	5
55 or more	7	13	7	11
Total	52	101	62 [c]	100

[a] For the purpose of calculating the area per person, infants under one year were not counted, each child between one and 10 years counted as half a person, and each member of the household aged 10 years or more counted as one person.

[b] 1 ft^2 = 0.09 m^2.

[c] One patient, a nun who was living in a dormitory, has been excluded.

Living accommodation

The area of living accommodation per person for the families of patients in the home series is set out in Table 5. It will be seen that, at the time of admission of the patients to treatment, one was homeless, 75% lived in accommodation with less than 45 ft^2 per person and 42% in accommodation with less than 25 ft^2 per person.[1] According to the recommendations of the Environmental Hygiene Committee of the Government of India [India, Ministry of Health, 1950), the total floor area of living-rooms should not be less than 50 ft^2 per person; by this criterion, most of the families were living in overcrowded conditions. Although there were some changes in the accommodation in the first year, these resulted in very little improvement in the area of living space (Tuberculosis Chemotherapy Centre, 1959). Records were not kept of all the details of subsequent changes in accommodation.

Pregnancy

Seven of 16 females of child-bearing age had a total of 12 pregnancies in the five-year period, four starting in the first year, three in the second, one in the third, two in the fourth and two in the fifth year.

Concluding remarks

The diet was not assessed in the fourth or fifth year and complete records were not kept, after the first year, of every change in occupation or of all the details of changes in the area of living accommodation. However, from the available data, it may be concluded that the dietary intake and accommodation were stable throughout the period of follow-up.

In summary, most of the patients in the home series with bacteriologically quiescent disease at one year had achieved this state, and maintained it throughout the period of follow-up, despite a deficient diet, unfavourable living accommodation, little rest and an early return to their normal occupations, which, frequently, were arduous.

SANATORIUM SERIES

Dietary intake [2]

The dietary intake at the five assessments in the first three years after admission to the study is set out in Table 6 for the 63 patients in the sanatorium series who had quiescent disease throughout the follow-up period.

Calories. The total daily intake was 1800 calories or more in 98 % of the patients at the assessment in the first year, during which time they were in sanatorium. There was a decline in intake after discharge from sanatorium; thus, the proportion with an intake of 1800 calories or more was 52 % at 18 months, 49 % at 24, 64 % at 30 and 58 % at 36 months.

Proteins. All the patients had a total protein intake of 50 g or more at the assessment undertaken while they were in sanatorium. After discharge, the proportion with an intake of 50 g or more decreased, being 41% at 18 months, 37% at 24, 39% at 30 and 48% at 36 months. Considering the intake of animal protein (not tabulated here), all the patients had at least 30 g a day during the first year, 28 (44%) having 50 g or more. In contrast, after discharge from sanatorium, most patients had less than 20 g, the proportions being 71% at 18 months, 83 % at 24, 84% at 30 and 84% at 36 months; the proportions of patients who received less than 10 g were 46%, 52%, 49% and 50%, respectively.

[1] 1 ft^2 = 0.09 m^2.

[2] See footnote on page 556.

TABLE 6

DIETARY INTAKE OF PATIENTS IN THE SANATORIUM SERIES WHO HAD BACTERIOLOGICALLY QUIESCENT DISEASE THROUGHOUT THE FOUR-YEAR PERIOD OF FOLLOW-UP

Dietary intake	Time of assessment									
	luring the first yea		18 months		24 months		30 months		36 months	
	No.	%	No.	%	No.	%	No.	%	No.	%
Calories:										
Less than 1 400	0	0	16	25	17	27	12	20	10	16
1 400 - 1 799	1	2	14	22	15	24	10	16	16	26
1 800 - 2 199	16	25	17	27	11	17	17	28	10	16
2 200 - 2 599	33	52	7	11	10	16	9	15	13	21
2 600 or more	13	21	9	14	10	16	13	21	13	21
Total proteins (g) :										
Less than 30	0	0	8	13	11	17	7	11	7	11
30-39	0	0	16	25	14	22	12	20	17	27
40-49	0	0	13	21	15	24	18	30	8	13
50-59	3	5	10	16	8	13	9	15	14	23
60-69	19	30	8	13	7	11	3	5	12	19
70 or more	41	65	8	13	8	13	12	20	4	6
Fats (g):										
o-9	0	0	15	24	16	29	14	23	14	23
IO-19	0	0	17	27	19	30	18	30	17	27
20-29	0	0	10	16	12	19	11	18	12	19
30-39	0	0	7	11	5	8	6	10	14	23
40-49	4	6	10	16	4	6	6	10	2	3
50 or more	59	94	4	6	5	8	6	10	3	5
Carbohydrates (g):										
Less than 200	0	0	5	8	3	5	3	5	1	2
200-299	1	2	20	32	17	27	12	20	12	19
300-399	43	68	17	27	21	33	15	25	19	31
400-499	16	29	13	27	13	21	15	25	14	23
500 or more	1	2	8	13	9	14	16	26	16	26
Total patients	63	100	63	100	63	100	61 [a]	100	62 [b]	100

[a] Excluding two patients who were not assessed. [b] Excluding one patient who was not assessed.

Fats. During the first year all (100%) of the patients received 40 g or more of fats, as compared with only 22 % at 18 months, 14% at 24, 20 % at 30 and 8% at 36 months. At every assessment after discharge from sanatorium, a substantial proportion of patients had less than 20 g of fats–namely, 51% at 18 months, 59 % at 24, 52% at 30 and 50% at 36 months.

Carbohydrates. Nearly all the patients (97%) had a daily carbohydrate intake of between 300 and 500 g while in sanatorium, 30% having an intake of 400 g or more. After discharge from sanatorium,

there was greater variability in the intake of the patients. On the average, the intake in the second year was about the same as that in sanatorium, but in the third year it was slightly higher; the proportions of patients receiving 400 g or more were 33 %, 35%, 51% and 48 % at 18, 24, 30 and 36 months, respectively.

In summary, during the first year, when the patients were in sanatorium, they had an adequate and well-balanced diet in terms of calories, proteins, fats and carbohydrates. On discharge from sanatorium, however, there was a sharp decline in the intake of calories, proteins and fats.

Minerals and vitamins. The intake of minerals and vitamins has been calculated for the assessment in sanatorium in the first year and that at home at 18 months but is not tabulated here. Calculations for the later assessments (at 24, 30 and 36 months) have not been undertaken for the reasons stated earlier (page 556).

Calcium: At the assessment undertaken during the first year, 57 (90%) of the patients had a calcium intake of 1 g or more, as compared with 12 (19 %) patients at the assessment at 18 months. It has not been possible to make allowance for the consumption of betel with slaked lime, a practice which is believed to have been more common after the patients' discharge from sanatorium.

Phosphorus: All the patients had a phosphorus intake of 1 g or more a day while in sanatorium, the great majority–namely, 50 (79 %)–receiving 1.5 g or more a day. At 18 months, the corresponding figures were 23 (37%) and 6 (10%), respectively

Iron: Of the 63 patients, 33 (52%) had an iron intake of less than 20 mg a day at the assessment in sanatorium and 29 (46%) received between 20 and 25 mg. At 18 months the corresponding figures were 44 (70 %) and 10 (16 %), respectively.

Vitamin A : Only one patient had a vitamin A intake of less than 1500 IU daily while in sanatorium; he received 1450 IU. A large majority–namely, 54 (86%)–received between 1500 and 2500 IU daily. At the assessment at 18 months, 60 (95%) of the patients had an intake of less than 1000 IU daily, 50 of them receiving less than 500 IU.

Carotene: The daily intake of carotene was between 600 and 1000 IU in 42 (67%) of the patients at the assessment in sanatorium and 1000 IU or more in 20 (32%). At the assessment at 18 months, 32 (51%) had less than 600 IU, 11 (17 %) received between 600 and 1000 IU, and 20 (32%) received 1000 IU or more.

Thiamine: During the first year, 43 (68%) of the patients had a thiamine intake of 600 IU or more and no patient received less than 400 IU. At 18 months the corresponding figures were 4 (6%) and 34 (54%), respectively.

Riboflavine: During the first year, 62 (98 %) of the patients had a riboflavine intake of 1500 µg or more daily; at 18 months, all (100%) received less than 1500 µg, 53 (84 %) receiving less than 500 µg daily.

Nicotinic acid: At the assessment in sanatorium the intake of nicotinic acid was less than 15 mg a day in only 4 (6%) of the patients, the remaining 59 (94%) having an intake of between 15 and 25 mg a day. At 18 months, 32 (51%) had less than 15 mg a day, 28 (44%) had 15-25 mg and 3 (5%) had 25 mg or more.

Ascorbic acid: At the assessment in sanatorium the intake of ascorbic acid was less than 25 mg in only 3 (5%) of the patients; the majority–namely, 37 (59%)–received between 25 and 50 mg. At 18 months, the corresponding figures were 21 (33 %) and 16 (25 %), respectively.

In summary, while in sanatorium, the majority of patients had an intake of more than 2000 calories a day, the diet containing substantial amounts of fats and proteins (particularly of animal origin) as well as carbohydrates, and being adequate in the mineral and vitamin content. On discharge from sanatorium there was a sudden drop in calorie intake mainly due to low fat and protein intakes. There was also a decline in the intake of phosphorus and vitamins.

Weight changes

The weight changes are set out in the right-hand side of Table 2 and in Fig. 1, separately for the males and females.

The males gained, on the average, 15.3 lb in the first 6 months and 2.2 lb in the second 6 months. In the second year, there was a moderate loss in weight, but little change subsequently; over the five-year period, the average gain in weight was 13.2 lb. The females gamed, on the average, 16.5 lb in the first 6 months and 7.2 lb in the second 6

months. However, there was a substantial loss of weight in the second year and also losses in the third and fourth years. Even so, over the five-year period there was an average gain of 14.6 lb.

Physical activity and occupation

While in sanatorium, all the patients had very limited physical activity (Tuberculosis Chemotherapy Centre, 1959) and, even at the end of the year, the longest they were allowed up was four hours a day. On discharge from sanatorium, they experienced an immediate and major increase in their physical activity and, at 13 months, 86% were on part-time or full-time activity (Table 3, right-hand side). At 18 months, 86% were on full-time activity, as were 98% at 24, at 30, at 48 and at 60 months.

The main occupation of the sanatorium patients in the second year is shown in Table 4. Of the 63 patients, two were unemployed and 18 were housewives. The rest were in full-time employment in a variety of trades which often involved long hours of work and considerable physical activity.

Living accommodation

Throughout the first year, the patients were nursed in well-ventilated and spacious wards in the sanatorium, which was in a rural area. On discharge from sanatorium, they returned to their overcrowded homes. A detailed study was made of the accommodation which the families of the sanatorium patients occupied *at the time of diagnosis* of the disease; the results are set out in Table 5. It will be seen that 5 % of the patients were homeless and that a further 79 % were living in accommodation which provided less than 45 ft^2 per person, 39% having less than 25 ft^2 per person. For all practical purposes this represents the accommodation to which the patients returned on discharge from sanatorium since very little change in the standards of accommodation of the family took place in the first year.

Pregnancy

Nine of 25 females of child-bearing age had a total of 11 pregnancies in the five-year period, four beginning in the second year, one in the third, four in the fourth and two in the fifth. One of the last two terminated in an abortion.

Concluding remarks

Details of dietary intake in the fourth and fifth years and of accommodation after the first year were not available, but it may be concluded from the available data that the dietary intake and accommodation were stable throughout the period of follow-up.

In summary, the patients had ample rest for the whole of the first year, good accommodation and an adequate diet, and it was under these conditions that their disease attained bacteriological quiescence. On discharge from sanatorium at the end of the year, there was a marked increase in physical activity and usually a rapid return to the normal occupation. There was a return to overcrowded accommodation and a sudden decline in the dietary intake, and both the diet and accommodation remained unfavourable for the rest of the five years. Even so, the patients maintained bacteriological quiescence of their disease throughout the period of follow-up.

IV. PATIENTS WHOSE DISEASE RELAPSED BACTERIOLOGICALLY

As already mentioned, 5 (9%) of the 57 patients in the home series had a bacteriological relapse as did 7 (10%) of the 70 patients in the sanatorium series. For these patients, the findings of the dietary assessments undertaken prior to the relapse, the maximum weight gain, the weight gain at the time of the relapse, the weight change in the six months immediately prior to the relapse, the physical activity at the time of relapse, the occupation and information on the living accommodation are given in Table 7.

HOME SERIES

One patient (P34) showed a declining dietary intake (Table 7) at 18 and at 24 months and had a relapse in the 27th month. A second patient (P154), who showed a fairly stable dietary intake at all five assessments, had a relapse in the 57th month. A third patient (P163) showed a slight increase in dietary intake at the assessment at 18 months, which was four months before she had a relapse. The remaining two patients (P178 and P182) had a

TABLE 7

SUMMARY OF FINDINGS UP TO THE TIME OF RELAPSE IN THE PATIENTS WHOSE DISEASE RELAPSED BACTERIOLOGICALLY

Serial No.	Month of relapse	Dietary assessments before relapse (cf. Table 1 for home series and Table 6 for sanatorium series)								Maximum weight gain (lb) [a]	Weight gain at time of relapse (lb) [a]	Weight change in 6 months prior to relapse (lb) [a]	Physical activity at time of relapse (cf. Table 3)	Occupation at time of relapse (cf. Table 4)	Area of accommodation per person (ft^2) [b] (cf. Table 5)
		During the first year				At 18 months	At 24 months	At 30 months	At 36 months						
		Calories	Proteins (g)	Fats (g)	Carbohydrates (g)	Calories	Calories	Calories	Calories						
Home series															
P34	27	3 607	76	55	690	2 814	1 937	–	–	6	3	+ 1	Full-time	Office boy	71
P154	57	2 204	64	21	417	1 739	2 285	1 995	1 992	27	10	– 6	Full-time	Housewife	33
P163	22	1 529	31	8	480	1 766	–	–	–	16	12	– 11	Full-time	Housewife	27
P176	15	2 800	89	45	423	–	–	–		19	17	+ 5	Full-time	Accountant	38
P182	16	1 591	40	10	227	–			–	36	29	+ 9	Part-time	Housewife	31
Sanatorium series															
P19	54	2 250	65	53	375	1 693	2 253		2 079	7	0	- 6	Full-time	Cycle shop assistant	16
P60	17	2 056	62	54	328					12	7	- 6	Full-time	Dhobi	16
P90	18	2 936	92	71	479		–	—		16	6	- 6	Full-time	Housewife	13
P132	14	2 438	67	54	418			—		36	35	- 6	Full-time	Housewife	67
P159	15	2 343	79	75	404			—	–	28	12	- 1 6	Full-time	Housewife	15
P181	13	2 360	73	60	421			—	–	21	20	- 2	Full-time	Farmer	116
P191	14	2 194	73	62	348			—		26	19	- 7	Full-time	Unemployed	50

[a] 1 lb = 0.45 kg.

[b] 1 ft^2 = 0.09 m^2.

relapse at 15 and 16 months, respectively, and so had only had one dietary assessment. There is no suggestion that these five patients were at a special dietary disadvantage in comparison with the patients who had quiescent disease throughout the period of follow-up (Table 1), nor that their occupations, physical activity and accommodation were particularly unfavourable.

Three patients had gained weight and two had lost weight in the six months immediately prior to the relapse; all five weighed more at the time of the relapse than at the time of their admission to the study.

All three females of child-bearing age became pregnant, two of them before they had a relapse. One of these two became pregnant in the ninth month, had residual cavitation at one year, received calcium in the second year and had a relapse at 22 months (she became pregnant again in the 41st month); the other became pregnant in the 13th and in the 40th month, and had a relapse at 57 months. The third started a pregnancy 14 months after the relapse.

SANATORIUM SERIES

The assessments of the patients in the sanatorium series, which are presented in the lower part of Table 7, show features similar to those of the patients in the home series.

It will be noted that all seven patients lost weight (average loss, 7.6 lb) in the six months immediately preceding the relapse, which occurred between 12 and 18 months in six of them. (It is of interest that, during this period, about 70% of the sanatorium patients whose disease remained quiescent throughout also lost weight, the average loss being 3.4 lb for the whole group and 7.0 lb for those who actually lost weight.)

There were three females of child-bearing age of whom two became pregnant on one or more occasions. One, who had residual cavitation at one year and received isoniazid in the second year, became pregnant in the 16th month and had a relapse at 18 months. The other started pregnancies two and 11 months after the relapse, both terminating in abortion.

TIMING OF THE RELAPSES IN THE TWO SERIES

Three of the five patients in the home series and six of the seven in the sanatorium series had a relapse in the second year. Of these, the relapse occurred early–i.e., between 12 and 18 months–in two patients in the home series and all six in the sanatorium series. This finding suggests that relapse in some of the sanatorium patients might have been due to one or more of the factors associated with the return of the patients to the home environment at the end of the year–namely, clearly inferior diet, markedly increased physical activity, early resumption of normal occupation and return to very overcrowded living accommodation.

V. THE ROLE OF CHEMOTHERAPY IN THE PREVENTION OF RELAPSE IN THE TWO SERIES

As already mentioned, the patients with bacteriologically quiescent disease at one year were allocated at random either to a placebo, calcium gluconate, or to isoniazid in the second year. The relapse rates are given in Table 8, separately for cavitated and non-cavitated disease at one year It will be seen that whereas chemotherapy with isoniazid in the second year did not apparently reduce the number of relapses among the patients with cavitated disease at one year, it prevented ***any*** relapse among the patients with non-cavitated lesions at one year, irrespective of whether they had been treated in the first year at home or in sanatorium. Thus, even if relapse in individual patients may result from environmental stresses acting on the disease (see above), there is evidence that continuation therapy with isoniazid alone can prevent such relapse in patients without residual cavitation. In patients with residual cavitation at one year, there is evidence from another study (Great Britain, Medical Research Council, 1962) that continuation chemotherapy with a combination of isoniazid and PAS can prevent about 80% of the relapses.

TABLE 8. BACTERIOLOGICAL RELAPSES IN THE FOUR-YEAR PERIOD OF FOLLOW-UP

Place of treatment in first year	Treatment during the second year	Patients with bacteriologically quiescent disease throughout follow-up period	Patients with bacteriologically relapsed disease	Month of bacteriological relapse
Patients with cavitation at one year				
Home	Calcium	9	1	22
	Isoniazid	9	1 *	15
Sanatorium	Calcium	8	0	—
	Isoniazid	10	3	13, 15, 18
Both series	Calcium	17	1	22
	Isoniazid	19	4	13, 15, 15, 18
Patients without cavitation at one year				
Home	Calcium	16	3	16, 27, 57
	Isoniazid	18	0	–
Sanatorium	Calcium	21	4	14, 14, 17, 54
	Isoniazid	24	0	
Both series	Calcium	37	7	14, 14. 16, 17, 27, 54, 57
	Isoniazid	42	0	–

* Misclassified at 12 months as having bacteriologically active disease and so continued to receive isoniazid plus PAS.

VI. DISCUSSION

Earlier papers from the Centre (Tuberculosis Chemotherapy Centre, 1959; Ramakrishnan et al., 1961) reported on the role of diet, physical activity and accommodation in the response to treatment of patients with pulmonary tuberculosis. These factors had been studied in a comparison, based on random allocation, of two groups of patients, all of whom had received a standard oral regimen of isoniazid plus PAS for one year. One group was treated at home in overcrowded and unfavourable accommodation, had a bare subsistence diet and little rest, and returned early to work. The other group was treated in sanatorium in large airy wards and received a good diet and ample rest during the whole year. Despite the differences in the environmental factors in the two groups, the patients treated at home fared almost as well, in terms of the attainment of bacteriological quiescence at one year, as the patients treated in sanatorium (Tuberculosis Chemotherapy Centre, 1959). In a study, also based on random selection, in Ghana, Bell (1960) compared in-patient and out-patient treatment for three months with a daily injection of streptomyclidine isonicotinic acid hydrazide. He found no difference in the response to treatment between the two series even though the out-patients had received an inferior diet, had not been restricted in their physical activity and had been permitted to continue work if they felt well enough to do so.

The present report is based on patients admitted to the home and sanatorium study mentioned above, and gives information on the diet, physical activity, occupation and living accommodation of the patients with bacteriologically quiescent disease throughout the four-year period of follow-up, as well as for those whose disease relapsed bacteriologically during this period. This information is of particular interest as the environment of the patients in the home series during the period of follow-up was similar to that in the first year in terms of diet,

accommodation, physical activity and occupation; thus, their diet was the " poor South Indian " diet (Patwardhan, 1952; Dakshinamurti & Devadatta, 1956), the accommodation overcrowded and a number had arduous occupations and long hours of work. Even so, the great majority of the 57 patients–namely, 52 (91 %)–maintained bacteriologically quiescent disease throughout the four-year period of follow-up. The environmental background of the patients in the sanatorium series in the first year is in sharp contrast. They had a good diet and ample rest in large airy wards and gained, on the average, a very considerable amount of weight during the year. At the end of the year they were discharged from sanatorium to their overcrowded accommodation and, at the same time, not only suddenly received a markedly inferior diet but also returned to full physical activity; in the majority of instances, they had resumed their normal occupations within a few weeks after discharge. Not surprisingly, there was a moderate loss of weight in these patients in the second year, particularly between 12 and 18 months. However, despite all these sudden changes in the environment, the great majority of the 70 sanatorium patients-namely, 63 (90 %)–had bacteriologically quiescent disease throughout the four-year period of follow-up. Thus bacteriological quiescence of the disease, whether it had been attained under treatment at home or under the much more favourable conditions in sanatorium, was stable and even the sudden environmental changes in the sanatorium series did not disturb quiescence in the *great majority* of patients.

It is relevant that six of the seven patients in the sanatorium series who had a bacteriological relapse, as compared with two of the five in the home series, had it between 12 and 18 months, sugesting that the sudden stresses of returning to the home environment may have been responsible for the relapse in some of these six sanatorium patients. There are, however, good reasons for believing that most of the relapses in *both series* could have been prevented by chemotherapy in the second year. Thus, in the combined home and sanatorium series, not one bacteriological relapse occurred among the 42 patients who had no residual cavitation at one year and received (as a result of random allocation) isoniazid in the second year (22 of these patients received isoniazid in the third year also), as compared with seven among the 37 patients on the placebo, calcium gluconate (three of these seven relapses occurred between 12 and 18 months in patients in the sanatorium series). Chemotherapy was therefore capable of overcoming all subsequent disadvantageous environmental factors in patients with no residual cavitation at one year. Although isoniazid alone at the dosage used did not apparently influence the relapse rate in the patients with residual cavitation, evidence from another study (Great Britain, Medical Research Council, 1962) suggests that combined chemotherapy with isoniazid plus PAS might have done so.

It may be concluded that the earlier study (Ramakrishnan et al., 1961) and the present study together have shown that the diet, the amount of rest and the type of accommodation of patients-traditionally factors of importance in the treatment of patients in the pre-chemotherapy era–are, at most, of minor importance not only in the immediate response to treatment (Ramakrishnan et al., 1961), but also in the occurrence of relapse (present report), if *effective chemotherapy is administered for an adequate period of time.* Bacteriological quiescence of the disease at one year, as produced by chemotherapy, has proved to be stable in the great majority of patients, irrespective of the environmental background in which the chemotherapy was administered.

Finally, it must be stressed that this study has been concerned with the importance of various environmental factors in the response to treatment of patients receiving effective chemotherapy for active pulmonary tuberculosis, and in the occurrence of relapse among such patients. The findings provide no information on the effect of diet, physical activity and living accommodation on the susceptibility of the individual to tuberculosis, on the spread of the disease in the community or on the progression of the disease in *undiagnosed* or *diagnosed but untreated or inadequately treated cases.*

VII. SUMMARY

1. A study was undertaken of the diet, physical activity, occupation and living accommodation of 127 South Indian patients with pulmonary tuberculosis whose disease had attained bacteriological quiescence after one year of treatment with isoniazid plus PAS.

2. During the first year, 57 of the patients had been treated at home and 70 in sanatorium. As a result of random allocation procedures at one year and at two years, about a quarter of the patients were prescribed isoniazid alone for two years, another quarter were prescribed isoniazid for one year and the remainder were prescribed no specific chemotherapy. All patients have been followed up to the end of five years.

3. Dietary assessments were undertaken on admission to treatment, at some time between 6 and 12 months, and at 18, 24, 30 and 36 months; all the assessments were made by the *same* assessor, who used the oral questionnaire technique.

4. Of the 57 patients treated at home in the first year, 5 (9%) had a bacteriological relapse, as compared with 7 (10 %) of the 70 patients treated in sanatorium. There was no suggestion that the patients who had a relapse were at a special dietary disadvantage in comparison with those who had quiescent disease throughout, nor were there any appreciable differences in the occupations, physical activity and living accommodation. However, there was some evidence that the stresses of suddenly returning to the home environment may have been responsible for some of the relapses in sanatorium patients.

5. The 52 patients in the home series who maintained quiescent disease throughout the period of follow-up did so under conditions usually considered to be adverse. Thus, they had throughout a predominantly carbohydrate diet which was low in calories, total and animal proteins, fats, phosphorus, iron and vitamins. Further, about three-fourths of them lived in overcrowded accommodation (less than 45 ft^2 per person), and nearly all were usually on full-time activity in occupations which were often arduous and involved long hours of work.

6. The 63 patients in the sanatorium series who maintained quiescent disease throughout the four-year period did so despite suddenly being subjected to the stresses of a return to the home environment –namely, inferior diet, increased physical activity and overcrowded accommodation–after a year in sanatorium during which they had received an adequate and well-balanced diet, had undertaken very limited physical activity and had been nursed in well-ventilated and spacious wards.

7. It may be concluded that, despite adverse environmental conditions, bacteriological quiescence attained by the administration of effective chemotherapy for one year has proved to be stable over four years in the great majority of patients.

8. This study does not provide information on the influence of environmental factors on the susceptibility of the individual to tuberculosis, on the spread of the disease in the community or on the progression of disease in untreated or inadequately treated cases.

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RÉSUMÉ

Dans un article précédent, les auteurs ont montré que, dans une communauté économiquement et socialement défavorisée de l'Inde méridionale, la réponse des tuberculeux pulmonaires à un traitement d'un an par l'association isoniazide-PAS était quasiment la même, que la cure soit effectuée au sanatorium ou à domicile, dans les conditions défavorables de leur milieu habituel.

L'enquête actuelle porte sur 127 malades, dont 57 avaient été soignés à domicile et 70 au sanatorium, et qui, à l'issue de cette année de traitement, étaient bactériologiquement négatifs. Tous reçurent un complément de traitement à domicile, à l'exception d'un groupe témoin: un quart environ d'entre eux reçut un traitement d'entretien par l'isoniazide pendant deux ans, un autre quart le même traitement pendant un an et le groupe témoin du placebo. La surveillance fut poursuivie pen-

dant quatre ans, période au cours de laquelle l'alimentation des malades, leur activité physique et leurs conditions générales de vie furent étudiées.

Au cours des quatre années d'observation, les cas de rechute bactériologique furent au nombre de 5 (9%) chez les 57 malades antérieurement soignés à domicile, et de 7 (10%) chez les 70 malades soignés antérieurement au sanatorium. Cinquante-deux des malades soignés à domicile au cours de la 1re année se maintinrent donc bactériologiquement négatifs, malgré des conditions d'existence très défavorables: régime riche en hydrates de carbone, mais pauvre en calories, en protéines, graisses, phosphore, fer et vitamines; logements surpeuplés et reprise précoce d'un travail pénible, pour la plupart d'entre eux. Quant aux malades traités la première année au sanatorium, et ayant bénéficié durant cette période d'un maximum de repos, de bonnes conditions de logement et d'une alimentation convenable, ils durent affronter, à leur sortie d'hôpital, les conditions communes: malgré ce changement radical, 90% d'entre eux restèrent bactériologiquement négatifs pendant les quatre années de surveillance.

Les auteurs concluent que, malgré des conditions très défavorables, la guérison bactériologique obtenue après un an de chimiothérapie efficace s'est maintenue chez la grande majorité des malades. Ils soulignent par ailleurs que leur enquête ne se proposait pas d'étudier le rôle du milieu sur la sensibilité individuelle à la tuberculose, la propagation de la maladie dans une communauté ou son évolution en l'absence de traitement.

REFERENCES

Aykroyd, W. R., Gopalan, C. & Balasubramanian, S. C. (1963) The *nutritive value of Indian foods and the planning of satisfactory diets,* 6th ed., New Delhi. (Indian Council of Medical Research, *Special Report Series,* No. 42)

Aykroyd, W. R., Patwardhan, V. N. & Ranganathan, S. (1951) *The nutritive value of Indian foods and the planning of satisfactory diets,* 4th ed., Simla, Government of India Press, p. 5

Bell, W. J. (1960) *Brit. J. Dis. Chest,* **54,** 247

Dakshmamurti, K. & Devadatta, S. C. (1956) *Proc. Indian Acad. Sri.,* **43,** 121

Devadatta, S., Andrews, R. H., Angel, J. H., Bhatia, A. L., Fox, W., Janardhanam, B., Radhakrishna, S., Ramakrishnan, C. V., Subbaiah, T. V. & Velu, S. (1961) *Bull. Wld Hlth Org.,* **24,** 149

Great Britain, Medical Research Council (1962) *Tubercle (Lond.),* **43,** 201

India, Ministry of Health, Environmental Hygiene Committee *(I 950) Report of the. . . October 1949,* Simla, p. 21

Pasricha, S. (1958) *Indian .J. med. Res.,* **46,** 605

Pasricha, S. (1959) *Indian J. med. Res.,* **47,** 207

Patwardhan. V. N. (1952) *Indian J. med. Sci.,* **6,** 139

Ramakrishnan, C. V., Rajendran, K., Jacob, P. G., Fox, W. & Radhakrishua, S. (1961) *Bull. Wld Hlth Org.,* **25,** 339

Tuberculosis Chemotherapy Centre (1959) *Bull. Wld Hlth Org.,* **21,** 51

Velu, S., Andrews, R. H.; Devadatta, S., Fox, W., Radhakrishna, S., Ramakrishnan, C. V., Selkon, J. B., Somasundaram, P. R. & Subbaiah, T. V. (1960) *Bull. Wld Hlth Org.,* **23,** 511

Annex

DETAILS OF THE LIVING ACCOMMODATION OF THE PATIENTS

In order to give a clearer picture of the type of accommodation occupied by the patients in this study, the photographs of three typical houses-two interior views (Fig. 2 and 4) and one exterior view (Fig. 3)–are reproduced in this annex. For this purpose, the houses of the patients' families were classified into three groups, according to the area of living accommodation available per person: namely, less than 25 ft^2 (2.3 m^2), 25-44 ft^2 (2.3-4.1 m^2) and 45 ft^2 (4.2 m^2) or more (see Table 5); from each of these three groups, one house has been selected for reproduction here.

FIG. 2

PATIENT No. T1248 *ACCOM-*
MODATION WITH LESS THAN 25 FT^2 PER PERSON

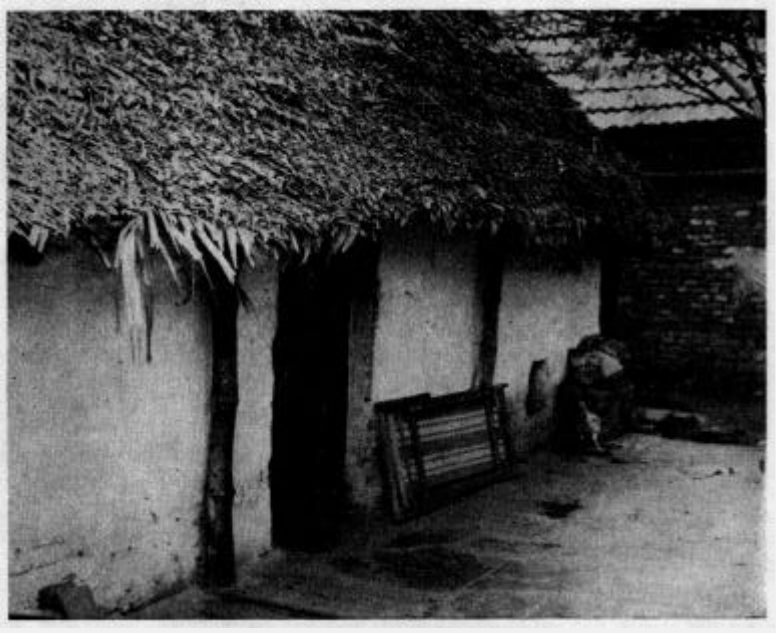
Brick and tile house, occupied by three families.

Accommodation occupied by patient and family: Two rooms, a verandah/kitchen and a common courtyard; water tap and lavatory shared with the other two families; no electricity. Total floor area, 115 ft^2 (10.7 m^2).

Family composition: Patient, husband, two children (aged 2 and 6 years), and four adult in-laws.

FIG. 3

PATIENT No. T1487: ACCOMMODATION WITH 25-44 FT² PER PERSON



Brick and thatch house. occupied by four families.

Accommodation occupied by patient and family: One room and a kitchen; water tap and lavatory shared with the other three families: no electricity. Total floor area, 182 ft² (16.9 m²).

Family composition: Patient, husband, four sons (aged 1,5,8 and 15 years) and two daughters (aged 10 and 16 years).

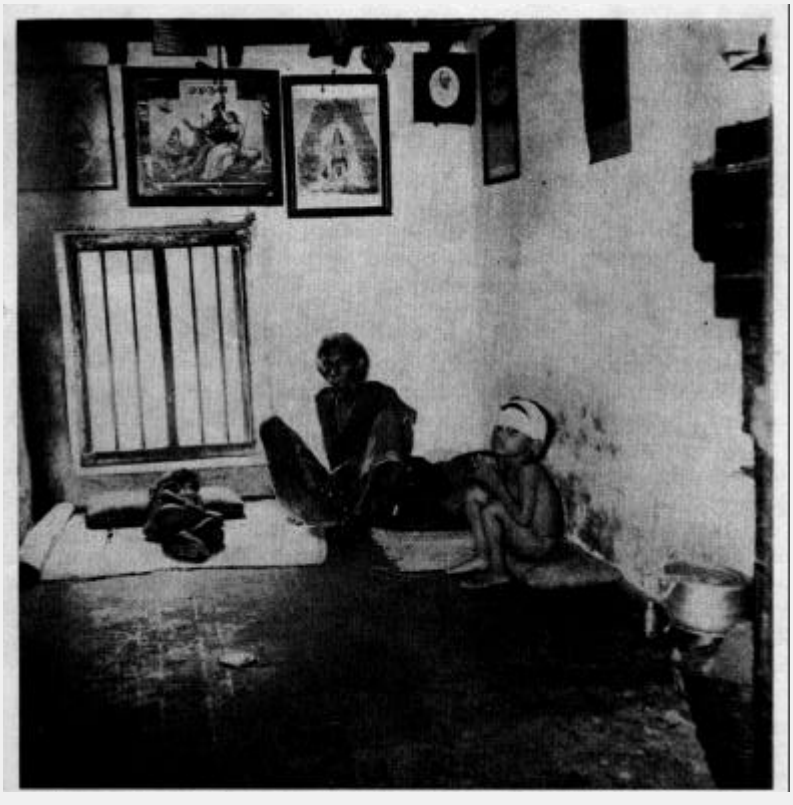


FIG. 4

PATIENT No. T1003: ACCOMMODATION WITH 45 FT² OR MORE PER PERSON

Brick and tile house, occupied by six families.

Accommodation occupied by patient and family: One room, a kitchen, a verandah and a common courtyard; water tap and lavatory shared with the other five families: no electricity. Total floor area, 278 ft² (25.6 m²).

Family composition: Patient, mother, brother, sister-in-law and nephew (aged 1 year).

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